CMOS IMAGE SENSOR AND METHOD FOR FABRICATING THE SAME

FIELD OF THE INVENTION

The present invention relates generally to a semiconductor device, and, more particularly, to a CMOS image sensor capable of preventing a surface of a metal line therein from being damaged or contaminated, thereby improving performance of a semiconductor memory device.

BACKGROUND OF THE INVENTION

As is well known, an image sensor is an apparatus generating image data by sensing a light beam reflected from an object. An exemplary image sensor fabricated by a complementary metal oxide semiconductor (CMOS) technology is called a CMOS image sensor.

Generally, the CMOS image sensor includes a plurality of unit pixels, each unit pixel including a light sensing element and a plurality of transistors. The light sensing element, such as a photodiode, senses an incident light beam and generates photoelectric charges corresponding to the amount of the incident light beam received. The transistors perform switching operations to control transfer of the photoelectric charges.

FIGS. 1A to 1D are cross-sectional views showing sequential steps of fabricating a conventional CMOS image sensor. Here, reference numerals **100** and **150** represent a unit pixel area and a pad area, respectively. For convenience purposes, the distance between the unit pixel area **100** and the pad area **150** has been truncated by a split view.

Referring to FIG. 1A, a series of operations are carried out to provide a semiconductor structure that has a metal line **101** on an upper portion thereof, the metal line **101** extending from the unit pixel area **100** into the pad area **150**. After forming an anti-reflection layer **102** of about 300 Å on the metal line **101**, an oxide layer **103** and a nitride layer **104**, together forming a passivation layer, are stacked on the entire structure extending from the unit pixel area **100** into the pad area **150**.

Referring to FIG. 1B, the nitride layer **104**, the oxide layer **103** and the anti-reflection layer **102** are selectively etched to expose a portion of the metal line **101** and create a pad open area **105**.

Referring to FIG. 1C, a dyed photoresist **106** is coated on the entire structure. Then, an exposure and development operation is carried out to form a color filter **106** over a light sensing region of the CMOS image sensor. At this time, a portion of the dyed photoresist **106**, i.e., the photoresist pattern **106*b***, covering the pad open portion **105**, is removed during the develop operation. Then, a thermal treatment is performed at a temperature of 145° C. to 150° C.

Referring to FIG. 1D, after patterning the color filter **106A**, the resulting structure is soaked in a developing solution. This soaking step erodes a portion of the surface of the metal line **107**, leaving a high resistance oxide layer **108**. This high resistance oxide layer **108** forms a poor contact with any metal ball connected thereto for driving the circuit.

It is, therefore, desirable to have a CMOS image sensor capable of preventing a surface of a metal line from being damaged, oxidized, or otherwise contaminated, thereby improving the performance of the semiconductor memory device.

SUMMARY OF THE INVENTION

In accordance with an aspect of the invention, there is provided a CMOS image sensor comprising: a semiconductor structure, wherein the semiconductor structure includes a unit pixel area and a pad area; a metal line formed on the pad area, wherein a portion of the metal line is exposed; a passivation layer formed on the unit pixel area and on the metal line such that the exposed portion of the metal line is left exposed; a planarized photoresist formed on a portion of the passivation layer; a micro-lens formed on a portion of the planarized photoresist; and an oxide layer formed on the micro-lens, the photoresist, and the passivation layer such that the exposed portion is left exposed.

In accordance with another aspect of the invention, there is provided a method for fabricating a CMOS image sensor, comprising the steps of: a) providing a semiconductor structure, wherein the semiconductor structure includes a metal line formed on an upper portion of the semiconductor structure; b) forming a passivation layer on the metal line; c) forming a planarized photoresist on a portion of the passivation layer; d) forming a micro-lens on a portion of the planarized photoresist; e) forming an oxide layer on the micro-lens, the photoresist, and the passivation layer; and f) forming a pad open mask and etching the oxide layer and the passivation layer to expose a portion of the metal line.

BRIEF DESCRIPTION OF THE DRAWINGS

An exemplary apparatus and method will now be described with reference to the accompanying drawings, in which:

FIGS. **1A** to **1D** are cross-sectional views showing sequential steps of fabricating a conventional CMOS image sensor;

FIG. **2** is a cross-sectional view illustrating an exemplary CMOS image sensor constructed in accordance with the teachings of the present invention; and

FIGS. 3A to 3E are cross-sectional views illustrating sequential steps in fabricating the CMOS image sensor shown in FIG. **2**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **2** is a cross-sectional view illustrating an exemplary CMOS image sensor constructed in accordance with the teachings of the invention. The illustrated CMOS image sensor includes a semiconductor structure having a unit pixel area **300** and a pad area **350**. The semiconductor structure also has a pad open area **310**; a metal line **301** of which a portion is exposed; an oxide layer **303** and a nitride layer **304**, which together serve as a passivation layer; a color filter **305**; a planarized photoresist **306** formed on the color filter **305** and the passivation layer; a micro-lens **307** formed on the planarized photoresist **306**; and a low-temperature oxide layer **308** formed on the entire structure (e.g., the micro-lens **307**, the photoresist **306**, and the nitride layer **304** of the passivation laser). The low-temperature oxide layer **308** is formed at a temperature of 150° C. to 200° C. and to a thickness of 3000 Å to 10000 Å. A photoresist layer **309** is also shown and described below. Preferably, the CMOS image sensor further includes an anti-reflection layer **302** formed on the metal line **301**.

FIGS. 3A through 3E show a method for fabricating the CMOS image sensor of FIG. 2. Referring to FIG. 3A, a series of fabricating operations are carried out to provide a semiconductor structure that has the metal line **301**. Then, to protect the semiconductor structure from moisture and scratching, the passivation layer (i.e., the oxide layer **303** and the nitride layer **304**) is formed on the entire structure.